Search Report

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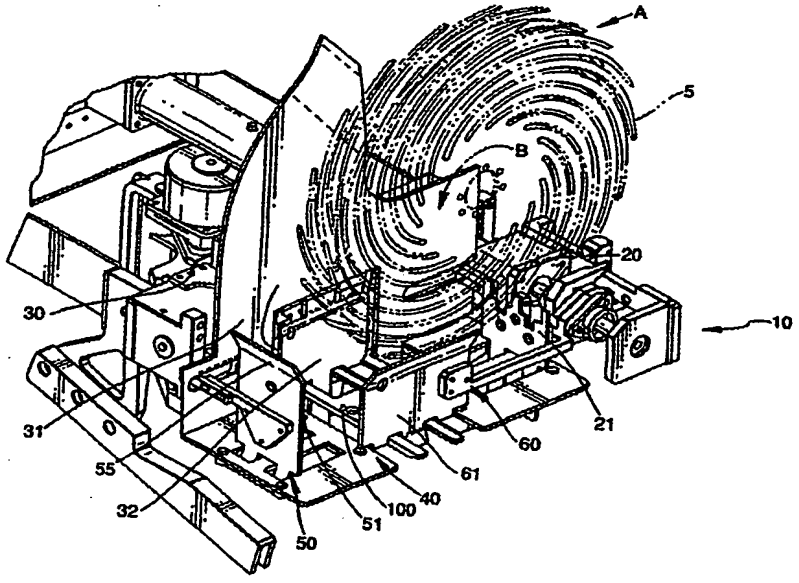

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(57) Abstract

Sheet stacking apparatus comprises a sheet store having a base (40) and at least one upright member (50) adjacent the base to define a wall of the store. A transport system (2) delivers sheets to the sheet store, which the at least one upright member (50) is adjustable relative to the base (40) to accommodate different size sheets. The apparatus further comprises a control system (11, 24, 35, 54, 63) including an adjust mechanism for adjusting the position of the first upright member, and a controller for receiving information defining the size of sheets to be stacked in the sheet store, determining the position that the first upright member should take up, and actuating the adjust mechanism accordingly.

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SHEET STACKING APPARATUS

The invention relates to sheet stacking apparatus of the kind comprising a sheet store having a base and at least one upright member adjacent the base to define a wall of the store; and a transport system for delivering sheets to the sheet store. Such apparatus is hereinafter referred to as of the kind described.

Sheet stacking apparatus of the kind described can be found in a variety of sheet processing apparatus but the invention is primarily concerned with the use of such apparatus in equipment for automatically sorting sheets of paper such as banknotes, cheques or other documents of monetary value. It is common practice in sorting equipment to transport the sheets, generally picked from a stack of common sized sheets at an input station, sequentially one after the other, through at least one sheet characteristic evaluation section into one of at least two transport paths to stack forming facilities, using belts or roller transport arrangements in which the sheets are transported between the belts or rollers, or vacuum drum/belt transports in which the sheets are held by suction to on to the moving surface. It is also common practice at each of the stacking positions to have the leading edge of the sheet entering the stack position strike or butt up to a stop plate to assist removal of the sheet from the final transport means and/or to provide a common datum for the leading edge of all the sheets being stacked at that position. Generally, because the sheets to be sorted are processed in batches having a common size and because it is not expedient between batches of sheets of different sizes to manually change their positions, the stop plates are positioned commonly at each of the stacker stations.

Furthermore, it is known to provide some means of controlling or restraining the lateral position of each of the sheets as they are being stacked by generally angling the sorting equipment such that gravitational force urges

each sheet, when it has left the transport, towards a fixed back plate and/or by providing manually adjustable stacker side plates having angled surfaces to assist the sheet being stacked into a preferred position. The disadvantages with these arrangements are that the state of the completed sheet stack depends very much on the physical condition of the sheets being stacked and the position or state of each individual sheet as it exits the final transport. The latter arrangement also depends on the operator remembering to undertake the manual adjustment each time the width of the sheets to be processed is changed. As can be understood, the biggest disadvantage with the known equipment is it is not suited to stacking sheets which have been sorted from batches of banknotes, cheques or other documents of monetary value, containing sheets having different size characteristics.

US-A-4374463 describes a sheet stacking apparatus in which manually adjustable stop and side plates are provided to allow an operator to position those plates at a desired location. The manual action of the operator is then communicated to a control system which can determine where sheets are to be fed. However, this suffers from the disadvantage mentioned above of requiring operator action.

In accordance with the present invention, sheet stacking apparatus of the kind described includes at least one upright member which is adjustable relative to the base to accommodate different size sheets and is characterised in that the apparatus further comprises a control system including an adjust mechanism for adjusting the position of the first upright member, and a controller for receiving information defining the size of sheets to be stacked in the sheet store, determining the position that the first upright member should take up, and actuating the adjust mechanism accordingly.

In contrast to the prior art, the new sheet stacking apparatus is automatically adjustable by the control system without the need for operator intervention. Typically, an

operator simply notifies the controller of the type of sheet to be stacked (for example denomination of banknote) and the controller sets the position of the first upright member accordingly. For example, the controller may include a store holding sheet dimensions which can be accessed depending upon the type of sheet being fed to determine the correct location for the first upright member. In the case of sorting apparatus, the operator will advise the controller of a range of sheet identities and the controller will set the first upright members of a set of sheet stores accordingly. There is no longer any need for an operator physically to adjust the first upright member or even to have knowledge of the size of the sheets to be stacked.

Typically, the at least one upright member will comprise a stop wall towards which sheets are fed by the transport system. This provides the primary registration surface. However, the at least one upright member may instead comprise a side wall positioned substantially parallel with the direction in which sheets are fed to the store by the transport system. This will be useful in the case where the store is designed to hold sheets of varying widths.

Typically, at least two upright members are provided defining respective sides of the sheet store, each upright member being adjustable by the control system in accordance with the size of sheets to be fed.

In the most preferred arrangement, the store has four sides each defined by a respective upright member, each upright member being adjustable by the control system in accordance with the size of sheets to be fed. The ability to adjust all four sides leads to the most flexible system allowing the apparatus to compensate for offset feeding and to shift a stack laterally after it has been formed. This is particularly helpful where the stack is to be fed to automatic banding equipment.

It is often useful to be able to tamp sheets in the store following the stacking process. This could be carried out using a separate tamping member which is vibrated but is conveniently carried out by vibrating the or one of the adjustable upright members. This tamping movement which is a cyclic movement about a datum position should be contrasted with the bodily movement of the upright member carried out by the adjust mechanism. In practice, the upright member will be set to a position which allows a small clearance from the stacked sheets, thus permitting the to and fro tamping movement.

In some cases, the base may also be movable to and from a stacking position and this particularly convenient for transporting a stack of sheets from the stacking position to a banding position.

An example of a sheet sorting machine incorporating a number of sheet stacking apparatus according to the invention will now be described with reference to the accompanying drawings, in which:-

Figure 1 is a front view of a sheet sorter showing the several stack positions in which the sorted sheets are stacked;

Figure 2 is an isometric view of the stacker arrangement from above and the left side of a stacker with the back plate omitted for clarity;

Figure 3 is an isometric view of the stacker shown in Figure 2 from above and the right side;

Figure 4 is a top view of the stacker shown in Figure 2 with the back plate in position and the dust covers over the linear drives removed for clarity; and,

Figure 5 is a front view of the stacker shown in Figure 2.

Figure 1 is the front view of a sheet sorting machine 1 having four sorted sheet stacking stations 10A to 10D. The sheets to be sorted are transported by belts from a feeding station 2 along a transport path 3A through three sheet evaluation sections 4A-4C where sheet

characteristics, such as length or width, pattern and authenticity features used to determine the sheet destination are monitored. The individual sheets being transported are then fed along a transport path 3B to a diverter 6 which is selectively actuable under control of a controller 11 which receives data from the evaluation sections 4A-4C to divert the sheets either towards stacking wheels 5A or to the stations 10A-10D. Sheets not destined for one of the stacking stations 10 are thus diverted and stacked in a pocket 7. Operator instructions to the machine are input on a console 8 and received by the controller 11, typically a microprocessor, located behind the console. The stacking stations 10 form part of a stacking station module 12 having a mounting plate 9. The sorting machine can be extended by adding further stacking station modules to the left hand end of the machine pictured.

Referring to Figures 2 to 5, Figure 2 shows in dotted outline the pair of stacking wheels 5 of one of the sheet stacking stations 10A-10D (each having the same configuration and referred to hereinafter by the reference numeral 10) and the direction A in which individual sheets destined to be stacked by the stacker station 10 enter into the slots of the wheels 5. Anti-clockwise rotation in the direction indicated by the arrow B of the wheels 5 transports the sheets positioned in the slots of wheels 5 so that the leading edge of the sheet strikes or abuts a stripper plate 21 which forms part of the stacker station. Further rotation of the wheels 5 frees the sheet from the slots so that it falls into a sheet store 100.

The stacker station 10 includes the stripper plate 21 and a drive assembly 20, a stacker backplate 9 and the drive assembly 30, base plate 40, tail end plate and drive assembly 50 and sideplate and drive assembly 60 which together form a rectangular box 100 having sides consisting of plates 21,31,40,51 and 61, of which plates 21,31,51 and

61 are positioned by their respective drives forming an adjust mechanism operated by the controller 11.

Figure 4 shows the assemblies 20,30,50 and 60 mounted to the stacking station module backplate 9.

Stripper plate assembly 20 comprises of the stripper plate 21 attached to an arm 22 which itself is attached to a stripper plate drive arm 23 forming part of a linear drive 24 mounted to bracket 71 which is bolted to the rear face of stacker station module backplate 9. The position of assembly 21,22 and 23 is thus adjusted in the direction parallel to the face of the backplate 9 by the linear drive 24.

The stacker backplate assembly 30 comprises of the shaped stacker backplate 31 attached to a support plate 32 and flange 33, to a sleeve 34, which forms part of the linear drive 35 which is mounted by flange 36 of the linear drive mounting sleeve 38 to the rear face of stacker station module backplate 9. Spigot 37, which slides in a bush (not shown) in the backplate 9, is mounted to support plate 32. The position of assembly 31 to 34 and 37 is thus adjusted in the direction at right angles to the face of the backplate 9 by a linear drive 35.

Tail end or stop plate assembly 50 comprises of the tail end plate 51 attached to an arm 52 which itself is attached to the tail end plate drive arm 53. This forms part of a linear drive 54 which is mounted to bracket 71 bolted to the rear face of stacker station module backplate 9. The position of assembly 51,52 and 53 is thus adjusted in the direction parallel to the face of the backplate 9 by the linear drive 54. Tail end plate 51 is formed at an angle 55 towards its top edge to assist sheets entering the stacker to settle into the stacker box.

The stacker sideplate assembly 60 comprises of the sideplate 61 attached to an arm 62 which is itself attached to a bush 67 rotatably mounted to a threaded sleeve 68. Sleeve 68 forms part of a linear drive 63 which is mounted to plates 64,65 and which form part of a bracket 66 which

is bolted to the front face of the stacker station module backplate 9. Bush 67 is linked by a torsion spring 69 to plate 90 which is non-rotatably mounted to the sleeve 68 and which has an extension 91 which slideably bears on the tip edge of the bracket 66. Thus, the position of assembly comprising 61,62,67,68,69,90 and 91 is adjusted in the direction at right angles to the face of the backplate 9 by the linear drive 63. The assembly of 61,62,67 and 69 and 90 enables the sideplate 61 to be lifted pivotably about the axis of sleeve 68, against the action of spring 69 to assist the removal of any sheets stacked in the stacker box. Sideplate 61 is formed at an angle 67 towards its top edge to assist sheets entering the stacker to settle into the stacker box.

Linear drive 54, which is similar to the drive arrangements 24, 35 and 63, comprises of arm 53 which is attached to the sleeve 56 which is threaded onto a threaded shaft 57 which in turn is rotated by a stepping motor 80. Typically, therefore, a stepped input to the stepping motor 80, to rotate the shaft 57 in one direction, will cause the arm 53 to move a controlled distance in one direction. Similarly, an input to rotate the shaft in the opposite direction will move arm 53 a controlled distance in the opposite direction. A control system datum position for the arm 53 is established by moving it to a position where part of it, or part of one of the components assembled to it, abut a mechanical stop to cause the motor to stall. Accordingly, every step of input to the motor, to move the arm away from the stop, causes the arm to move a defined distance. Although this is the preferred means of achieving the desired linear drive, other linear drive arrangements, for example using DC motors and sensor feedback control arrangements could be used.

In a typical operation sequence, the machine shown in Figure 1 may be required to validate and sort four denominations of banknotes, for example £5, £10, £20 and

£50 supplied in bundles containing two known denominations. Each denomination of note is uniquely sized.

1) On switching on the sorting machine, the controller 11 initiates all of the linear drives 24,35,54, 63 at each of its stacking positions to drive their respective plates to a datum (stall) position.

2) The operator inputs the denominations of the banknotes to be initially sorted, for example £5 and £10 and selects the sorting routine. In this example, the machine will be used simply to verify the denomination and sort the two denominations from each other, valid £5s in stacker 10A and valid £10s in stacker 10C, questionable £5s in stacker 10B and questionable £10s in stacker 10D.

3) The sorter controller 11 looks up the sizes of the denominations initially inputted by the operator via the console 8 and at each stacking position controls the appropriate linear drives to move each of the plates forming the stacker box 100 to a position (the set position) which suits the size of the denomination to be stacked therein. Thus, the stacker boxes at stackers 10A and 10B are adjusted to suit the £5 and those at stackers 10C and 10D to suit the £10.

4) In the operating period in which the sheet sorter transport means is actioned to transport sheets to the stacker positions, the drives 54 and 63 which are attached to the tail end plate 51 and the side plate 61 respectively, at each of the stacking positions, are also controlled to cyclically drive the plates away from and then towards the set position so as to tamp the stacked sheets.

5) Upon completion of the task to sort the £5s and £10s, the operator clears the stackers of these denominations and keys in the denominations of the banknotes next to be sorted in the sorting routine, for example valid £20s in stacker 10A and valid £50s in stacker 10C, questionable £20s in stacker 10B and questionable £50s in stacker 10D.

6) The sorter controller 11 looks up the sizes of the denominations initially inputted by the operator and at each stacking position moves each of the plates forming the stacker box to a position (the set position) which suits the size of the denomination to be stacked therein. Thus, the stacker boxes at stackers 10A and 10B are adjusted to suit the £20 and those at stackers 10C and 10D to suit the £50.

Operation is then as before.

The invention can be used in sorting equipment which has sheet banding facilities.

CLAIMS

1. Sheet stacking apparatus comprising a sheet store having a base and at least one upright member adjacent the base to define a wall of the store; and a transport system for delivering sheets to the sheet store, wherein the at least one upright member is adjustable relative to the base to accommodate different size sheets characterised in that apparatus further comprises a control system including an adjust mechanism for adjusting the position of the first upright member, and a controller for receiving information defining the size of sheets to be stacked in the sheet store, determining the position that the first upright member should take up, and actuating the adjust mechanism accordingly.

2. Apparatus according to claim 1, wherein the at least one upright member comprises a stop wall towards which sheets are fed by the transport system.

3. Apparatus according to claim 1 or claim 2, wherein the at least one upright member comprises a side wall positioned substantially parallel with the direction in which sheets are fed into the store by the transport system.

4. Apparatus according to any of the preceding claims, wherein the control system is adapted also to vibrate the at least one upright member to tamp sheets in the store.

5. Apparatus according to any of the preceding claims, wherein at least two upright members are provided defining respective sides of the sheet store, each upright member being adjustable by the control system in accordance with the size of sheets to be fed.

6. Apparatus according to claim 5, wherein the at least two upright members are orthogonally arranged.

7. Apparatus according to any of the preceding claims, wherein the store has four sides each defined by a respective upright member, each upright member being

adjustable by the control system in accordance with the size of sheets to be fed.

8. Apparatus according to claim 7, when dependent on claim 4, wherein the control means is adapted to vibrate two of the upright members defining opposite sides of the store to tamp sheets in the store.

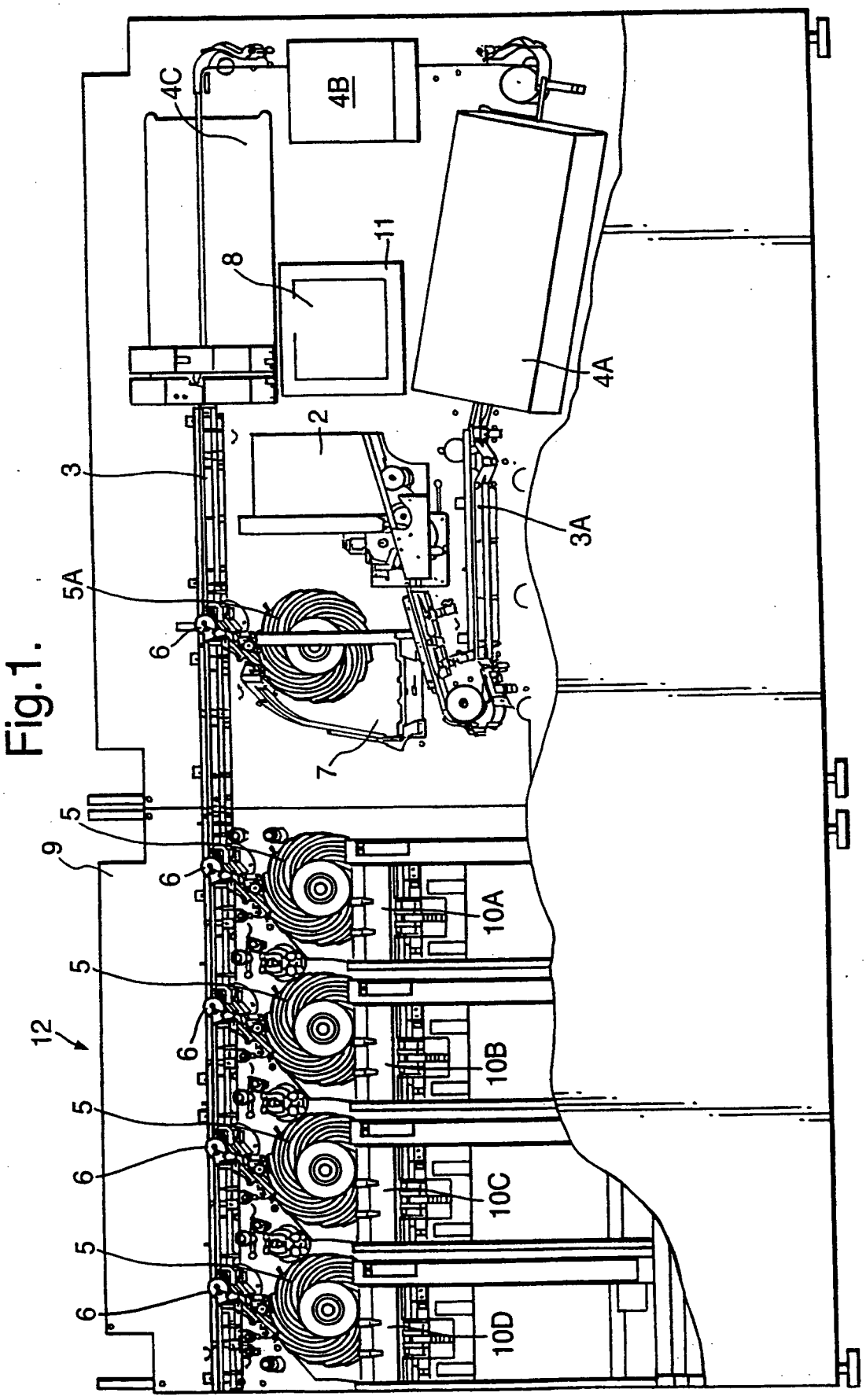

Fig.1.

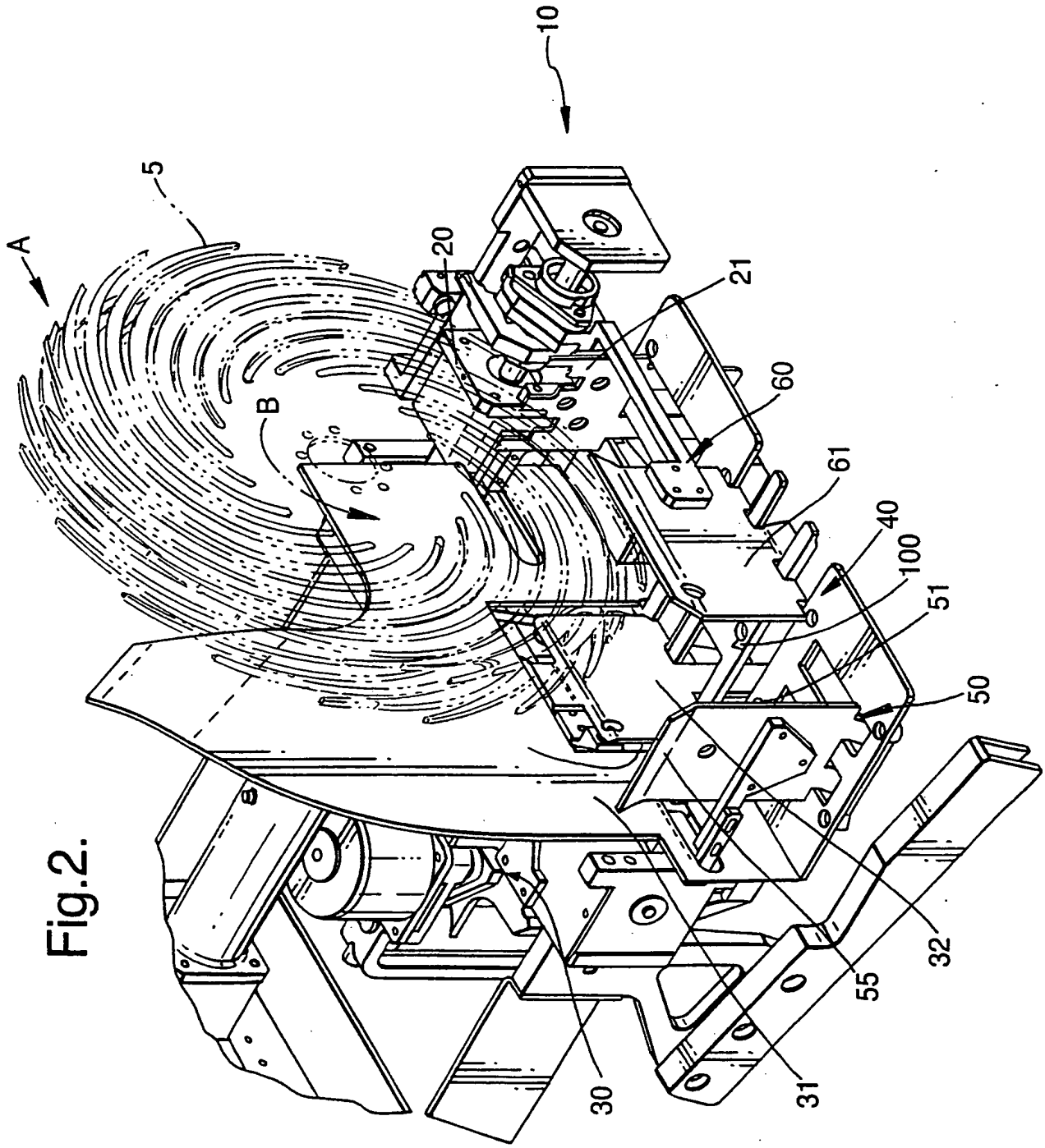

Fig.2.

Fig.3.

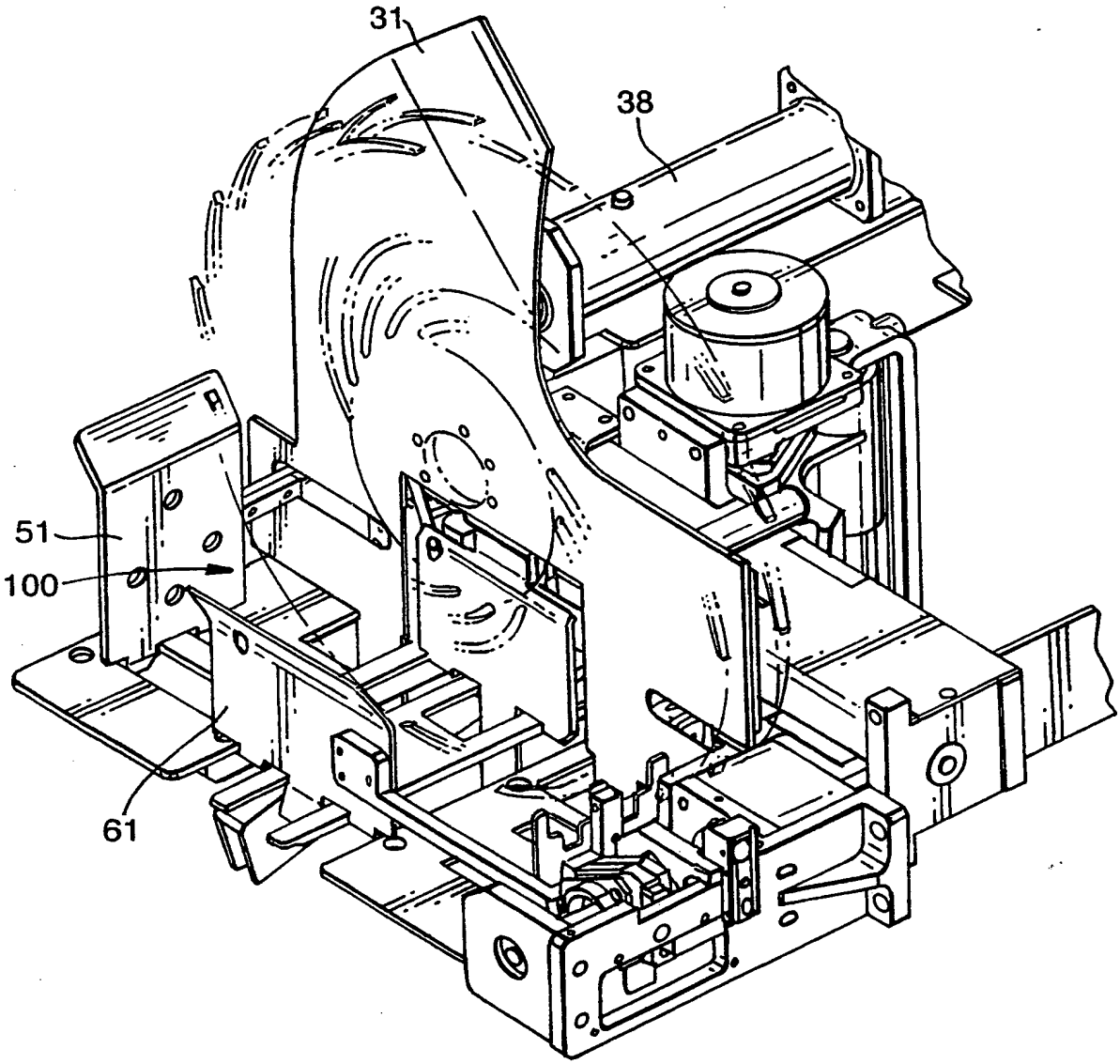

Fig.4.

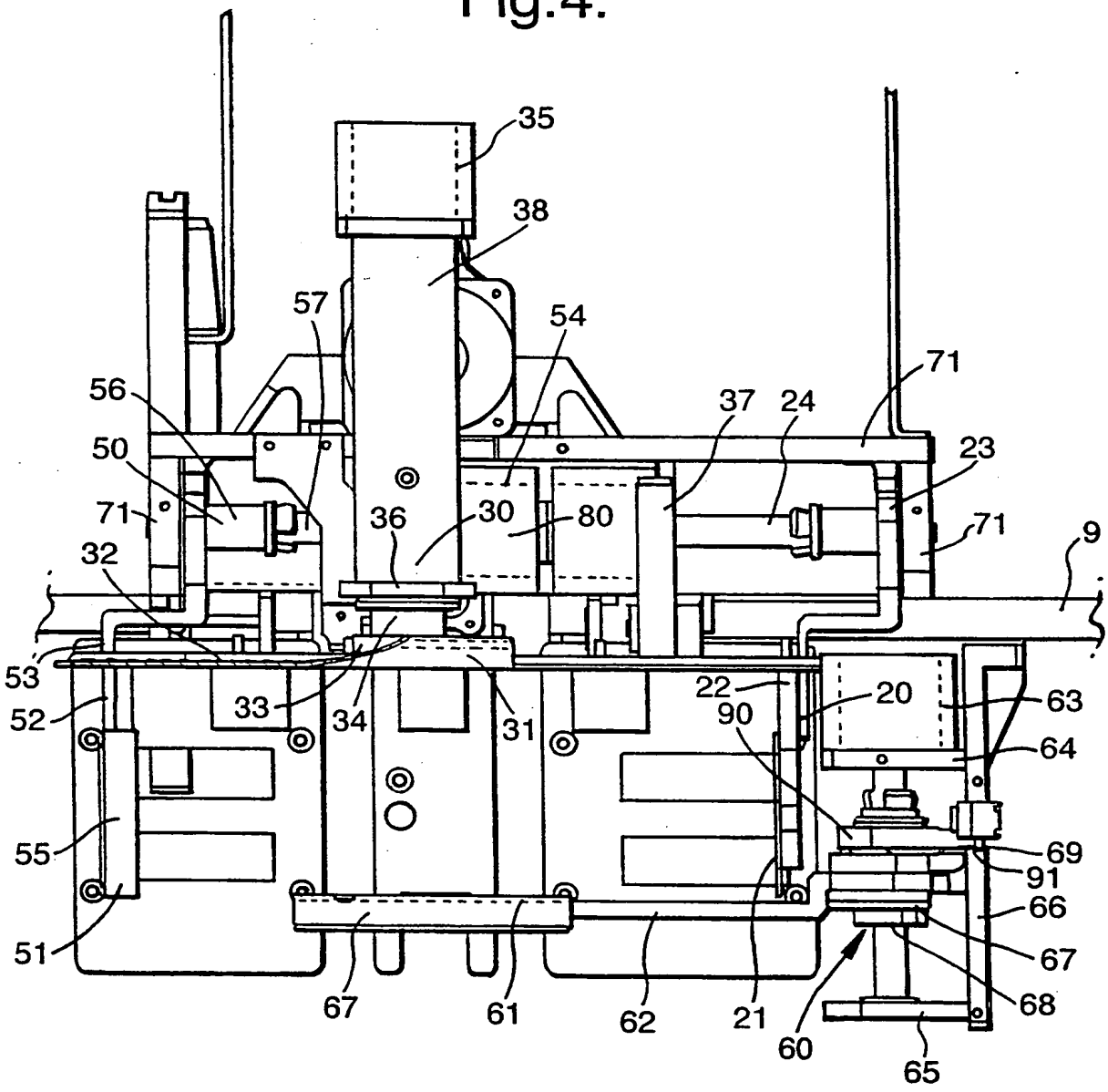
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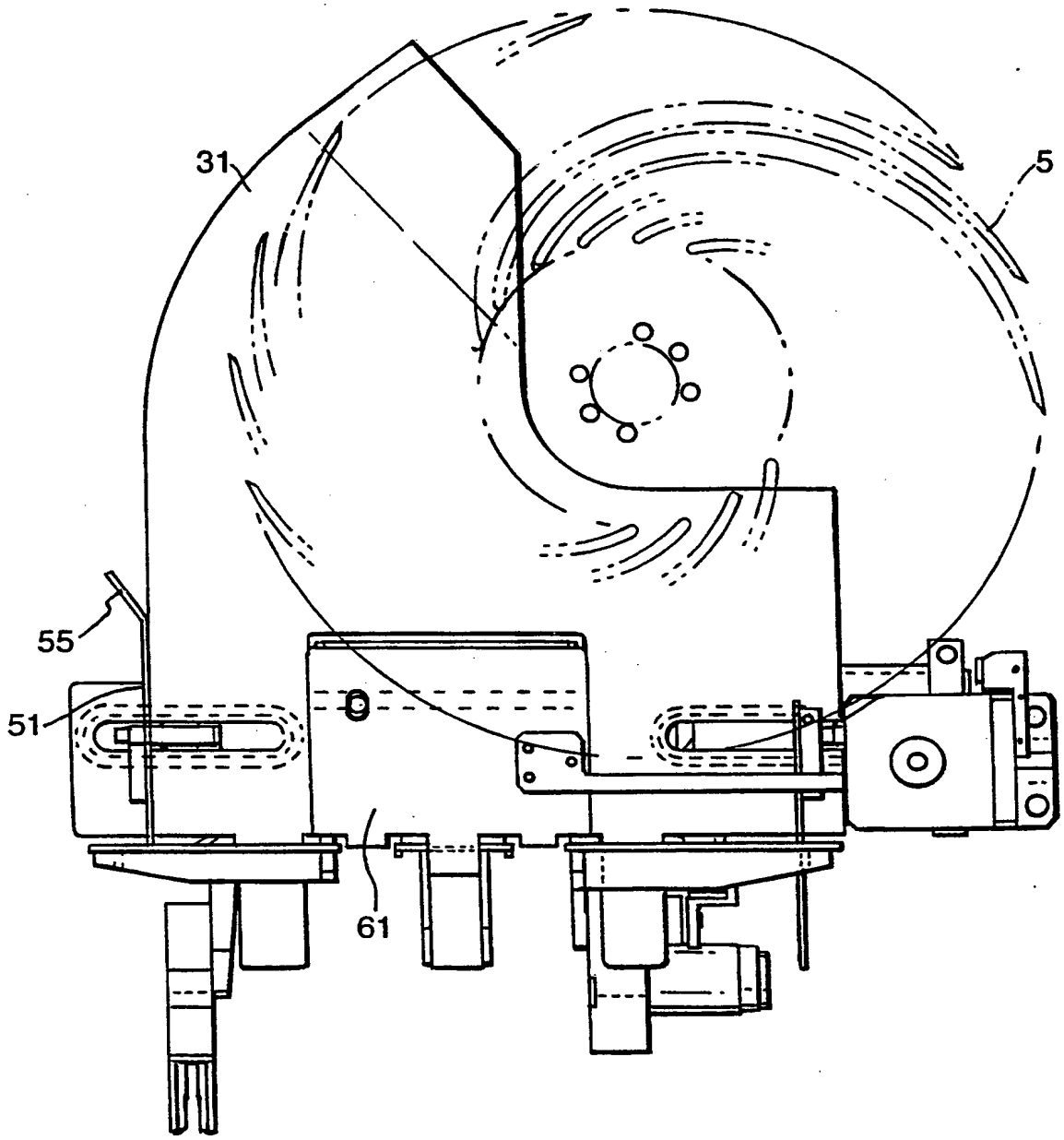
Fig.5.



INTERNATIONAL SEARCH REPORT

Int... nal Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B65H31/20 B65H31/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B65H B65B G07D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	US 4 339 119 A (SASAKI HIROSHI ET AL) 13 July 1982 (1982-07-13) column 6, line 30 -column 7, line 29; claims 1,7; figures 2,3	1-6,8
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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Information on patent family members

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